Code: 9D15103

M.Tech I Semester Regular & Supplementary Examinations February 2016

ADVANCED MECHANICS OF SOLIDS

(Machine Design)

(For students admitted in 2011, 2012, 2013, 2014 & 2015 only)

Time: 3 hours Max Marks: 60

Answer any FIVE questions

All questions carry equal marks

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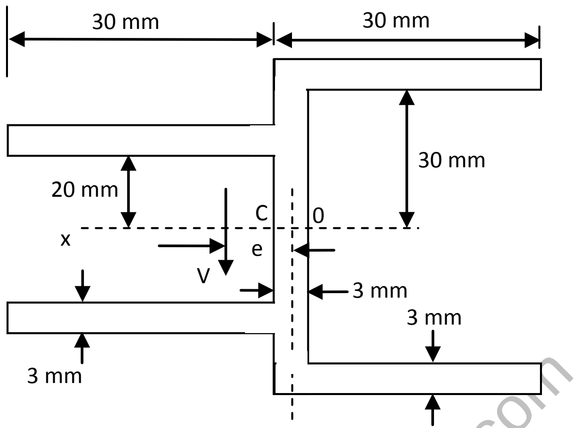
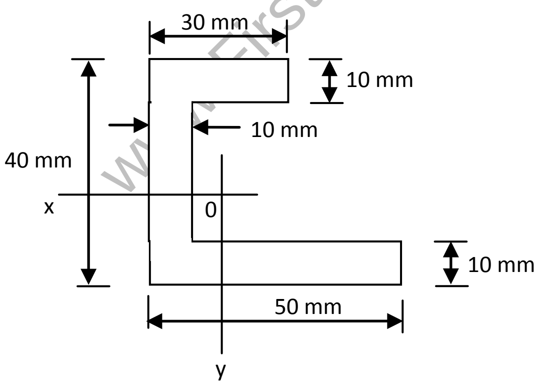
1 (a) What is shear centre and bending axis?

(b) Locate shear centre for given cross-section shown in figure below.

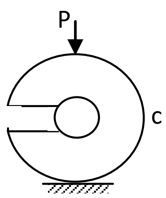


2 An extruded bar of aluminum alloy has the cross section shown in figure below. A 1.00 m length of this bar is used as a cantilever beam. A concentrated load P = 1.25 kN is applied at the free end and makes an angle of $\phi = 5\pi/9$ with the x axis. The view in figure is from the free end toward the fixed end of the beam. Determine the maximum tensile and compressive stresses in the beam.



3 (a) What are the stresses in chain links? Explain with example.

(b) The curved beam in figure below has a circular cross section 50 mm in diameter. The inside diameter of the curved beam is 40 mm. Determine the stress at B for P = 20 kN.



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4 (a) Explain Prandtl elastic membrane analogy.

(b) Two thin walled tubular members made of the same material, same length, the same thickness and the same total weight and are subjected to the same torque T. If their cross sections are circular and square respectively, what are the ratios of their stresses and angle of twist?

5 A feed roll (a device used to surface-finish steel shafts) consists of two circular cylindrical steel rollers, each 200 mm in diameter and arranged so that their longitudinal axes are parallel. A cylindrical steel shaft (60 mm in diameter) is fed between the rollers in such a manner that its longitudinal axis is perpendicular to the rollers. The total load P between the shaft and rollers is 4.5 kN. Determine the values of the maximum principal stress and maximum shear stress in the shaft. Determine the distance from the plane of contact to the point of maximum shear stress. Use E = 200 GPa and v = 0.29 for the shaft.

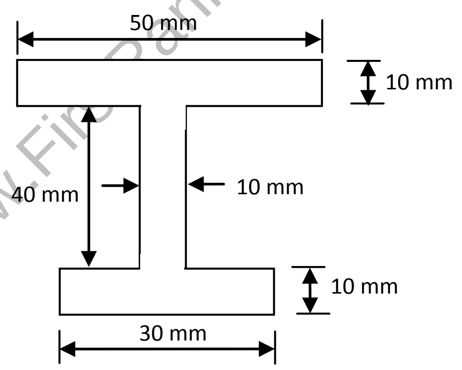
6 (a) Explain a plane stress and plane strain problem in rectangular coordinates with suitable example.

(b) At a critical point in a machine part, the nonzero components of stress are $\sigma_{xx} = 120\ MPa$, $\sigma_{yy} = 50\ MPa$ and $\sigma_{xy} = 50\ MPa$. The yield strength of the material is $\sigma_y = 300\ MPa$. Determine the factor of safety in the design based on the maximum shear stress criterion and that based on the octahedral shear stress criterion.

7 (a) Find the general form of $f(r)$ in the stress function $\theta f(r)$ and find expression for the stress components $\sigma_r, \sigma_\theta, \sigma_{r\theta}$. Could such a stress function apply to a closed ring.

(b) Sketch the stress – strain distribution for elastic plastic yielding of a beam. Also calculate the bending moment in the elastic-plastic state. The beam has rectangular cross section with width b and height h.

8 (a) A beam as shown in figure below is subjected to pure bending. The material has a yield point σ_y. Determine the ratio of the plastic moment and the maximum elastic moment.



(b) What is the twist of beam of circular uniform cross section for three dimensional problems?

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